ORIGINAL ARTICLE

Perfusion Index as a Predictor of Hypotension Following Subarachnoid Block in Elective Caesarean Section: A Prospective Study

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Abstract

Introduction: *Caesarean section is one of the most common procedures and commonly causes hypotension following subarachnoid block as a result of sympathectomy. As a result, there is venous pooling, so cardiac output decreases, which leads to hypotension. It becomes a major medical challenge to overcome. Various methods and agents has been applied to solve this problem. Perfusion index (PI) is one of such attempt to address the problem of hypotension. It may give a predictive value about which group of parturient may develop hypotension. The aim of the study was to use the non-invasive perfusion index data to predict the occurrence of hypotension in a parturient, so that it will help us to guide fluid and other drug therapy to address the problem of hypotension.*

Methods: *It was a prospective, observational study. This study was conducted in Department of Anaesthesia, Analgesia, Palliative and Intensive care medicine of Dhaka Medical College and Hospital from March 2017 to September 2019. Data were collected after approval from ethical review committee on January 2019. Total 80 patients were divided into two groups (40 in each) according to their base line perfusion index.*

Results: *The groups (group-I, PI of which was ≤3.5 & group-II, PI of which was > 3.5) were well matched for their demographic data. The mean age, height, weight and BMI were almost similar on both groups. The baseline readings of heart rate (HR), systolic blood pressure (SBP) and diastolic blood pressure (DBP) were almost similar in both groups. Single episode of hypotension developed in 6 (12.5%) patients of group-I, and 20 (50%) of group-II. Multiple episodes of hypotension in 2 (5%) patients of group-I, and 4 (10%) of group-II. A total of 8 (20%) patients developed hypotension in group-I and 24 (60%) in group-II. The difference was statistically significant ($p<0.05$) among two groups.*

Conclusion: *Perfusion index can reliably predict the hypotension, which may occur following subarachnoid block. So, it can be a great tool in obstetric anaesthesia.*

Key words: *Perfusion index, Hypotension, Subarachnoid block*

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Introduction:

Caesarean section is a common procedure and hypotension is the most commonly observed adverse event after subarachnoid block and have an incidence of 70%-80% for caesarean section.[1]

Hypotension may results in nausea and vomiting, loss of consciousness, aspiration, cardiac arrest and death of mother if not managed promptly. Fetal complications include low APGAR score, fetal hypoxia, distress, fetal acidosis, and brain damage. The anaesthesiologist is the chief person to maintain a normal or nearly normal physiology, and the only person to overcome the complications that may arise during anaesthesia and surgery.

As management of hypotension is crucial, so prior prediction of severe hypotension following subarachnoid

block during caesarean section is necessary. Many study has done to predict this hypotensive effect before anaesthesia is conducted.

Perfusion index (PI) is relatively a newer method to address the problem of hypotension. This is the ratio of pulsatile blood flow to non pulsatile blood flow in the peripheral vascular tissue, measured by a pulse oximeter based on the amount of infrared light absorbed. Pulse oximeter sensor calculate the PI, where pulsatile signal is divided by non-pulsatile signal and expressed as percentage.[2]

So, PI= (Pulsatile blood flow ÷ Non pulsatile blood flow) × 100.

PI indicates the initiation of general and epidural anaesthesia. Increasing in PI value indicates that there is vasodilatation and increased perfusion, which occurs after successful anaesthesia.

Various researcher of different countries suggested that perfusion index can be an important predictor of hypotension following subarachnoid block in caesarean section.[3,4,5,6] On those studies, they showed that when pre anaesthetic PI value is more than a defined range, there is increased incidence of development of hypotension in parturients undergoing caesarean section. So, the aim of this study was to assess the effectiveness of perfusion index to predict hypotension following subarachnoid block in elective caesarean section.

Methods:

This prospective observational study was conducted to assess the ability of perfusion index to predict about hypotension that might occurs after subarachnoid block in a parturient undergoing elective caesarean section at Dhaka medical College, Dhaka. Purposive sampling technique was adopted to select the sample population. A sample of 80 respondents was selected for study who were willing to participate and to provide required information.

Inclusion criteria were gestational age between 36-41 weeks, patients between 18-35 years of age. Any abdominal or gynaecological malignancies, patients with ante partum haemorrhage, pre-eclampsia, eclampsia, patients with coagulation disorders, patients with cardiovascular disease were excluded from study. The respondents were divided into two groups according to their baseline perfusion index. PI ≤3.5 was posted in Group-I and PI>3.5 was posted in Group-II.

All parturients were evaluated on the day or before the day of caesarean section. The parturients were kept fasting for at least 6 hours or rarely more hours, according to their individualized schedule of operation. To complete the whole procedure of data collection, two anaesthesiologists were required for blinding purpose. In operation theatre, one anaesthesiologist other than principal researcher recorded parturient's height & weight, and calculate body mass index (BMI). Intravenous infusion of Hartmann's solution was given at a volume of 15ml/kg over 15 minutes as preload.[7] Inj. Ondansetron, inj. Ranitidine was also given 15 minute prior to subarachnoid block. After preload, the baseline values (HR, BP, perfusion index) were recorded in supine position. Here the baseline perfusion index was the main parameter, as its value could give clue about hypotension of parturients following subarachnoid block. This gives an idea about vascular tonicity and perfusion status of that particular area, where the pulse oximiter probe is attached. If the baseline value is more, it will indicate that- there is less vascular tone and vice versa. Tonicity of that particular area may reflect the vascular tonicity of the whole body, specially the peripheral parts of the body. PI was measured by a specific pulse oximeter (Charmcare CX 100) which was attached to the right index finger of all parturients to ensure uniformity in measured PI values.

Subarachnoid block was performed by principal researcher and was blinded of baseline PI. Quincke's 25 gauge spinal needle was introduced in sitting position & 10 mg of bupivacaine 0.5% (hyperbaric) was given at the L3–L4 or L2–L3 inter space.[6] During this time pulse oximeter was disconnected to prevent bias. The parturient was returned to the supine position with a left lateral tilt of 15° to facilitate left uterine displacement,[8] both legs were slightly elevated[9] without head down to facilitate venous return. Pulse oximeter was reconnected to monitor the parturient till the end of surgery. Oxygen was given through oxygen mask at 5 L/min.

Hartmann's solution was administered at a rate of 100ml/10 min. The level of sensory block was checked and after confirmation of height of block achievement up to T6,[6] procedure (caesarean section) was started. Blood pressure was recorded at 2 min intervals after the subarachnoid block up to 10 minutes and then at 10 minutes intervals upto 30 minutes, and then 30 minutes interval till the end of surgery. Mean arterial pressure (MAP) was calculated by the formula of MAP= DBP+ (SBP-DBP)/3. Hypotension was defined as a decrease in MAP <65 mmHg[4,5] and treated with 5 mg injection ephedrine intravenously and 100 ml of Hartmann's Solution. The first hour following subarachnoid block was considered for anaesthesia induced hypotension.[3,4] Bradycardia was defined as HR

<60 beats/min and treated with injection atropine 0.6 mg IV slowly after dilution. After delivery of the baby, injection oxytocin 10 units were given intravenously slowly & another 10 unit oxytocin was given in 500ml of normal saline infusion.[10] Parturients requiring additional oxytocics and/or additional surgical interventions were excluded from the study. The incidence of other side effects such as nausea, vomiting, shivering, if observed was recorded. After completing whole of the procedure, the baseline data was collected, and filled in the prefixed data sheet.

Ethical implication:

Prior to the commencement of this study, the research protocol was approved by the Ethical Review Committee of Dhaka Medical College, Dhaka. The aims and objective of the study along with its procedure, risk and benefits were explained to the parturients, in easily understandable local language and then informed consent was taken from each parturient. It was assured that all records would be kept confidential and the procedure would be helpful for both the physician and patients in making rational approach regarding management of the case.

Results:

Total 81 patients were included in the study. One parturient was excluded due to inadequate level of the spinal blockade. Forty patients were in Group I and forty patients were in Group II for final analysis. The demographic parameters such as age, weight and height were comparable between the two groups (Table I).

Table I

Comparison of demographic characteristics between two groups

Parameter	G-I (n=40) PI≤3.5	G-II (n=40) PI>3.5
Age in years, mean (range)	24.03 (18-33)	25.38 (18-35)
Height in cm, mean (range)	152 (147-164)	151 (140-157)
Weight in kg, mean (range)	64.25 (47-89)	63.9 (46-90)

The mean PI value in Group I was 2.87 and in Group II was 6.36.

The difference of mean SBP at 2 min, 4 min and 6 min were significant between groups, The difference of mean DBP and MAP at 4 min was statistically significant between groups. All the values (SBP, DBP, MAP) following SAB were lower in group II than in Group I (Figure 1).

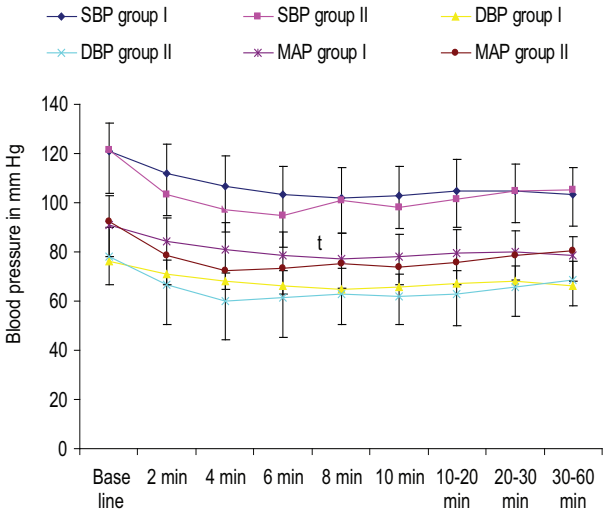

Figure 1: *Comparison of systolic blood pressure, diastolic blood pressure and mean arterial pressure between the two groups intraoperatively. Systolic, diastolic and mean arterial pressure values presented as mean ± standard deviation. Statistical analysis done using independent t-test P>0.05*

Hypotension was found in 8/40 (20%) parturients of group-I and 24/40 (60%) parturients of group-II, which were clinically significant. Single episode of hypotension developed in 6 (12.5%) parturients of group-I, and 20 (50%) of group-II. Multiple episodes of hypotension in 2 (5%) parturients of group-I, and 4 (10%) of group-II.

Table II

Number of episodes of hypotension, nausea and/ or vomiting.

Parameter	G-I (n=40) PI≤3.5	G-II (n=40) PI≤3.5	P-value
Nausea and/ or vomiting	0	9	
Episodes of hypotension			
No hypotension	32	16	<0.001
Single	6	20	
Multiple	2	4	

Spearman's rank correlation show positive correlation (r=0.375;p=0.001) between baseline PI against the episode of hypotension (Figure 2).

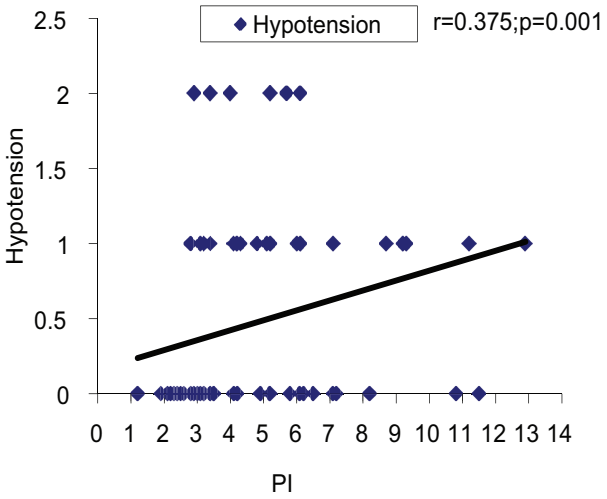

Figure-2: *Scatter diagram showing positive correlation (r=0.375;p=0.001) baseline PI with number of episode of hypotension.*

The ROC curve yielded 3.75 as a more appropriate cutoff with a 77.4% sensitivity and 67.3 specificity. The area under the ROC curve (AUC) was 0.736 (Figure 3).

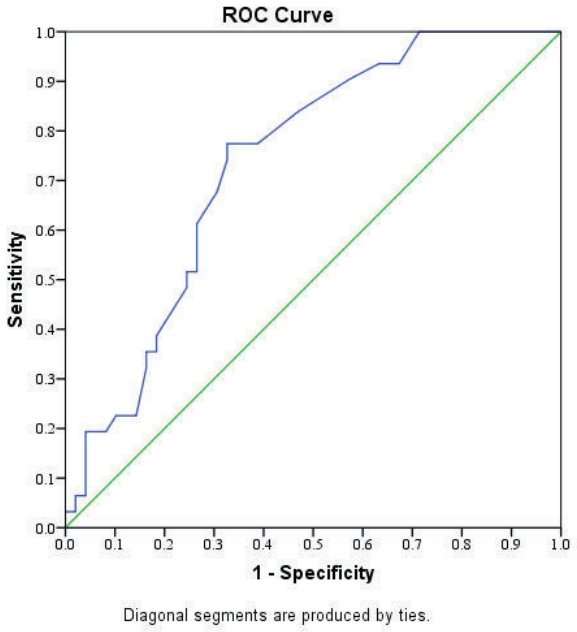

Figure-3: *ROC curve depicting baseline PI against incidence of hypotension.*

Cut of value	SEN	SPE	AUC	Asymptotic 95% CI	
				Lower bound	Upper bound
3.75	77.4	67.3	0.736	0.628	0.844

Discussion:

Perfusion index (PI) is a new tool that represents a noninvasive measurement of peripheral blood flow. It gives a result by measuring the ratio of pulsatile blood flow to the nonpulsatile or static blood in peripheral tissue such as in a fingertip, toe, or ear lobe. It indicates the status of the microcirculation which is innervated by sympathetic nerve fibres.[11] Its normal range is 0.02% to 20%, where lower PI indicates lower perfusion as well as weak pulse volume clinically and higher PI indicates the opposite. Clinical studies suggest that, it can be used as an early indicator of onset of general anaesthesia or regional anaesthesia, and also in neonatal care settings.

This prospective study was carried out with an aim to find out the predictability effect of perfusion index for development of hypotension following subarachnoid block in elective caesarean section. Parturients were divided into two groups of forty in each by their baseline perfusion index record. Parturients whose baseline PI was ≤3.5 were considered as group-I, parturients whose baseline PI was >3.5 were considered as group-II. The present study findings were discussed and compared with previously published relevant studies.

In this present study, it was observed that. The mean age was 24.03±4.69 years in group-I, 25.38±5.38 years in group-II. The difference was statistically not significant (p>0.05) among two groups.

The baseline values of HR, SBP and DBP were almost similar in both groups, but the baseline perfusion indexes were 2.84±0.55 for group-I & 6.37±2.33 for group-II. The difference of baseline PI was statistically significant (p<0.05) among two groups. In the study of Varghese, R. (2018), baseline PI was almost like this (2.69 and 7.18).

In this current study, the mean height was 1.52±0.03 m in group-I, 1.51±0.04 m in group-II. The mean weight was 64.25±9.88 kg in group-I, 63.9±11.41 kg in group-II. The difference was statistically not significant (p>0.05) among two groups.

Hypotension was defined as a mean arterial pressure <65 mmHg following subarachnoid block, during the 1st one hour of operation. Duggappa et.al (2017) and Varghese, R (2018) also accepted this value to define hypotension. Hypotension was found in 8/40 (20%) parturients of group-I and 24/40 (60%) parturients of group-II. Study by Toyama et al. (2013) showed 60% of their study population developed hypotension, among which more of the parturient's baseline PI was >3.5. (Value derived from the ROC curve). In another study by Duggappa et al. (2017) revealed hypotension for 10.5% parturients in group-I (PI≤3.5) and 71.42% in group-II (PI>3.5), new cut of value

was 3.85 derived from ROC curve. Study of Varghese, R. (2018) revealed 86.67% development of hypotension in higher baseline PI group, whereas it was only 6.67% in lower PI group.

In this study, the incidence of hypotension were more in those with PI > 3.5 with a 77.4% sensitivity and 67.3% specificity. Toyoma et al (2013) found 81% sensitivity and 86% specificity. In a study of Duggappa et.al. (2017), they found sensitivity of 89.29% and specificity of 69.84%, whereas in the study of Varghese, R (2018), the sensitivity was 86.67% and specificity was 93.33%, George, J. et.al (2019) found sensitivity of 80% and specificity of 60% in their study.

In this current study significant correlation between baseline PI >3.5 and number of episodes of hypotension was observed, which was similar to study by Toyama et al. (2013), Duggappa et al. (2017), Varghese, R (2018) and George, J et al. (2019) but in a study by Yokose et al. (2015) showed that PI has no predictive value[12] for hypotension in parturients undergoing caesarean section by subarachnoid block.

Through this discussion, we found many studies suggested about the prediction ability of PI for hypotension. In this current study, there is also a correlation between PI and incidence of development of hypotension. Therefore, it can be inferred that the baseline PI can be successfully used as tool for predicting hypotension following subarachnoid block in caesarean section.

Conclusion:

Perfusion index can reliably predict the hypotension, which may occur following subarachnoid block. So, it can be a great tool in obstetric anaesthesia.

Limitations:

In this study, invasive blood pressure was not recorded. However, arterial cannulation is not appropriate for uncomplicated elective caesarean section.

Perfusion index can easily decreased by sympathetic activation during stress and anxiety.

Base line values were recorded in supine position, whereas intra operative values were recorded in 15º left lateral tilt.

References:

1. Mercier F., Augè M., Hoffmann C., Fischer C., LeGouez A. Maternal hypotension during spinal anesthesia for caesarean delivery, Minerva Anestesiol, January, 2013, 79(1), 62-73.
2. Kumar A., Nadkarni AV. The variability of perfusion index as a new parameter in different types of anaesthesia techniques and its correlation with surgical stress and recovery from anesthesia: An observational clinical study, JMSCR, 2017, Vol.05, Issue.01, Page 15196-15265.
3. Toyama S., Kakumoto M., Morioka M., Matsuoka K., Omatsu H., Tagaito Y. et al. Perfusion index derived from a pulse oximeter can predict the incidence of hypotension during spinal anaesthesia for caesarean delivery, Br J Anaesth, 2013, 111, 235 41.
4. Duggappa DR., Lokesh M., Dixit A., Paul R., Rao R., Prabha P. Perfusion index as a predictor of hypotension following spinal anaestheia in lower segment caesarean section, Indian J Anaesth, 2017, August, 61(8), 649–654.
5. Varghese R. Perfusion index assessed from a pulse oximeter as a predictor of hypotension during subarachnoid block for caesarean section, JMSCR, 2018, Vol. 6, issue-5, p: 427-31.
6. George J., Valiaveedan S., Thomas M. Role of perfusion index as a predictor of hypotension during spinal anaesthesia for caesarean section-A prospective study, JMSCR, 2019, Vol. 07, Issue-03, Page 1208-1216.
7. Salama A., Goma H., Bassant M., Hamid A. Fluid preloading versus ephedrine in the management of spinal anesthesia-induced hypotension in parturients undergoing cesarean delivery: a comparative study, Ain-Shams J Anesthesiol, 2016, 9, 72–75.
8. Pakhare V., Kalyani S., Satya D., Chaitanya R., Kannuri M., Nagarjuna A. A randomized prospective study to compare the effect of wedge, manual displacement of uterus and no intervention, to reduce the hemodynamic effects of aortocaval compression in parturients undergoing caesarean section under subarachnoid block, Int J Med Res Prof, 2017, 3(3), 28-32.
9. Hasanin A., Aiyad A., Elsakka A., Kamel A., Fouad R., Osman M., et.al, Leg elevation decreases the incidence of post-spinal hypotension in cesarean section: a randomized controlled trial, BMC Anesthesiology, 2017, (17:60), p 1-6.
10. Lee A., Wong C., Healy L., Toledo P. Impact of a third stage of labor oxytocin protocol on cesarean delivery outcomes, Int J Obstet Anesth, 2014, (23), 18–22.
11. Mehandale SG., Rajasekhar P. Perfusion index as a predictor of hypotension following propofol induction - A prospective observational study, Indian j anaesth, 2017,Vol. 61, Issue.12, P-990-995.
12. Yokose M., Mihara T., Goto T. The predictive ability of non-invasive haemodynamic parameters for hypotension during caesarean section: a prospective observational study, Anaesthesia, 2015, 70, 555–562